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(15) **PATENT OF INVENTION**

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(71) Applicant: Bernard HIRIGOYEN, residing in France (Essonne)
(74) Agent: Jean-Michel Wagret, 10, rue de la Pépinière, Paris 8
(54) **Improvements in the coating of contact pieces in removable
connecting devices**
(72) Inventor:
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Improvements in the coating of contact pieces in removable connecting devices

The invention concerns improvements introduced in the linings and coatings used for protection and functioning of the contact surfaces of pieces cooperating with one another to secure the removable connection of parts; the invention, notably, concerns screw devices in which a threaded male part enters and is fastened in a receiving part such as a nut.

These pieces are generally made of metal and there are thus two pieces present, which are kept locked to one another for a period of time that can be very long, but that must allow their occasional separation upon disassembly.

It is well known that in the relative movement of mechanisms using threading or a screw-nut system, there are contact corrosion or metal/metal corrosion phenomena, which can appear on stopping as well as on operation.

On contact corrosion, in particular, oxides are formed at the interface, which are generally reddish and powdery for ferrous metals.

An abrasion is superposed on that corrosion, the two phenomena developing to the point of deep destruction of the opposite materials.

In metal/metal corrosion of electrochemical origin that corrosion appears when metals of different nature, structure and state are brought together.

A large number of factors, such as the nature of the metal, atmospheric environment, temperature and dissolved oxygen intervene to various degrees; in all cases, the two elements or pieces present define an interface where

infiltration waters more or less charged with salts or dissolved atmospheric anhydrides are lodged, thus constituting an electrolytic liquid leading to the formation of an oxidoreducing torque between the materials present and to the rapid development of oxides; the latter, forming a mass common to both parts and occupying a volume greater than that of the original pure materials, produce the seizure or permanent connection of the elements present.

It has been sought to remedy these disadvantages by lining the surfaces of the parts coming in contact with lubricating products capable of ensuring both protection and insulation of the surfaces, notably, with fatty substances; but the latter in liquid or pasty state are ejected by locking of the parts and the remaining film undergoes rapid decomposition, being incapable of ensuring electric insulation of the surfaces. The pieces are locked and one must resort to the use of unsticking oil in simple cases or even to a hammer or blowtorch for the most serious cases.

The invention is aimed at remedying those disadvantages and at securing, under the best conditions of durability, corrosion protection of the parts cooperating to provide the removable connection of the pieces, thus making it possible to maintain good operating conditions.

The invention is characterized in that the surface of at least one of the parts coming in contact and cooperating to ensure a removable bond, notably, the threadings in all their parts, flanges, crests and grooves, is provided with a specific coating consisting of a fluorinated resin film.

The protective film of the invention consists of polytetrafluoroethylene or PTFE, fluorethylenepropylene or FEP or even polyvinylfluoride or PVF.

As a variant, the electrically insulating and self-lubricating coating of the invention could be made of polyimide resin.

The invention is applicable to all the pieces of removable connecting parts and, notably, to threadings of screws and nuts, woods screws or the like.

The adhered or welded coating is of a regular predetermined thickness, depending on the nature of the underlying materials, that is, on the height of the crests and the wear resistance of the latter.

An improved engagement of the coating is obtained by ultrafine sanding, for example, or any other surface preparation process, according to known methods.

The coating proper can be made by any standard means or method, depending on the object sought:

- either by soaking in a fluidized powder bed,
- by projection with a gun,
- by soaking in a liquid dispersion,
- or by projection in an arc or plasma at very high temperature of materials in the form of dry powder.

The coating of the invention ensures perfect electric insulation of the parts in contact; it possesses sufficient stability enabling it to resist and remain free of plastic flow on locking of the parts after placement, by maintaining a continuous double layer between the two elements present, so that the possible infiltrations

no longer permit the establishment of electric contact of the metal pieces and of an oxidoreducing torque.

Furthermore, the coating of the invention by its physical presence counters solidification of the oxides developed from the two pieces, thus forming an actual weld.

In fact, assuming that under the insulating layer of the threading treated or, more generally, opposite the untreated surface, oxidation or rust (ferrous metals) is developed, without the presence of that film there will be an absolute interpenetration of the two metallic surfaces of the metals on stopping.

On the other hand, the protective film of the invention chemically and physically insulates the two pieces and makes it impossible for the oxides to join and be welded; the chemical inertia of the coating according to the invention will also enable it to withstand the corrosive action of the oxides and it may thus be possible to obtain easy disassembly of even strongly oxidized parts.

Furthermore, the remarkable fluorinated resin properties of having a very low friction coefficient secure for the threading thus treated perfect self-lubrication in operation, within a temperature range that normal lubrication cannot claim to cover, that is, from -200 to $+200^{\circ}\text{C}$.

The coating of the invention differs from the known art, using PTFE raw tapes (tightness of threading), in that the resins are polymerized into a coating of regular and predetermined thickness adhered or welded to the support metal.

An additional advantage on the industrial level is the cost or price saving.

The use of friction alloys, as in bronze nuts, is well known in mechanical engineering. Thanks to the fluorinated resin coating, these expensive alloys can be replaced by structural steel of considerably lower cost.

Furthermore, because of the increased hardness of the nut, the precision of movement, longevity and smoothness of operation of steel on steel coated with fluorocarbon resins are increased.

The applications of the invention are multiple and can be accommodated, notably, in all mechanical pieces providing contact and connection of two parts, while permitting their relative movement. The coatings of the invention can be adapted to the most diverse materials and, notably, to support metals. In particular, the invention makes possible a coating of the contact surfaces in precision gear, such as threads of adjusting screws of optical, watchmaking and targeting mechanisms or the like; in these different cases, mentioned by way of nonlimitative example, the coating of the invention further provides perfect electric and chemical insulation of the materials, avoiding any source of corrosion by oxidoreduction of the materials present, as well as constant self-lubrication in very wide temperature ranges from -200°C to $+200^{\circ}\text{C}$ and, finally, a smoothness of operation particularly appreciable when the parts in operation have to be handled manually, elimination of the frictional forces further making possible a far superior adjustment of precision; finally, anticorrosion protection and self-lubrication being permanently acquired, the parts in contact can be handled with constant sensitivity and precision without undergoing degradation over time, so

that an already old apparatus may be adjusted and handled as precisely as a new apparatus.

The foregoing description, having been given only by way of example of an embodiment of the invention, is not limitative in nature and several variants or embodiments of the invention may be made from the elements described without going beyond the bounds of the invention.

CLAIMS

1 - The invention concerns a method for making an insulating and self-lubricating protective coating on contact pieces cooperating with one another with a view to securing the removable connection of parts, such as screws, nuts or the like, characterized in that at least one of the working parts receives a fluorocarbon resin film on its surface in contact with the other part.

2 – Method according to 1, in which the insulating and self-lubricating protective film is polytetrafluoroethylene.

3 – Method according to 1, in which the insulating and self-lubricating protective film is fluorethylenepropylene.

4 – Method according to 1, in which the insulating and self-lubricating protective film is polyvinylfluoride.

5 – Variant of the method according to 1, in which the film is polyimide resin.

6 – Removable and detachable fastening part, such as a screw and/or nut, characterized in that it is coated with a self-lubricating and insulating protective film, as defined in Claim 2 above.

7 – Removable and detachable fastening part, such as a screw and/or nut, characterized in that it is coated with a self-lubricating and insulating protective film, as defined in Claim 3 above.

8 – Removable and detachable fastening part, such as a screw and/or nut, characterized in that it is coated with a self-lubricating and insulating protective film, as defined in Claim 4 above.

9 – Removable and detachable fastening part, such as a screw and/or nut, characterized in that it is coated with a self-lubricating and insulating protective film, as defined in Claim 5 above.